Nonsurgical correction of a Class III malocclusion in an adult by miniscrew-assisted mandibular dentition distalization

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This article reports the successful use of miniscrews in the mandible to treat a 20-year-old Mongolian woman with a chief complaint of anterior crossbite. The patient had a skeletal Class III malocclusion with a mildly protrusive mandible, an anterior crossbite, and a deviated midline. In light of the advantages for reconstruction of the occlusal plane and distal en-masse movement of the mandibular arch, we used a multiloop edgewise archwire in the initial stage. However, the maxillary incisors were in excessive labioversion accompanied by little retraction of the mandibular incisors; these results were obviously not satisfying after 4 months of multiloop edgewise archwire treatment. Two miniscrews were subsequently implanted vertically in the external oblique ridge areas of the bilateral mandibular ramus as skeletal anchorage for en-masse distalization of the mandibular dentition. During treatment, the mandibular anterior teeth were retracted about 4.0 mm without negative lingual inclinations. The movement of the mandibular first molar was almost bodily translation. The maxillary incisors maintained good inclinations by rotating their brackets 180° along with the outstanding performance of the beta-titanium wire. The patient received a harmonious facial balance, an attractive smile, and ideal occlusal relationships. The outcome was stable after 1 year of retention. Our results suggest that the application of miniscrews in the posterior area of the mandible is an effective approach for Class III camouflage treatment.

This technique requires minimal compliance and is particularly useful for correcting Class III patients with mild mandibular protrusion and minor crowding. (Am J Orthod Dentofacial Orthop 2013;143:877-87)

Smile attractiveness has been regarded as a standard of successful treatment by both orthodontists and patients. Evaluating the face in the smiling profile is also a critical part of a complete orthodontic diagnosis. Maxillary incisors play an important role in defining beauty, and thus they should be angulated and positioned most favorably in their anteroposterior and vertical relationships to all facial structures to ensure maximum facial harmony. Excessive labioversion of the maxillary incisors can easily ruin a pleasing smile.

Dentoalveolar compensations (proclined maxillary incisors and retroclined mandibular incisors) are common in patients with a Class III malocclusion caused by a retrognathic maxilla or a prognathic mandible. Also, moderate proclination of the maxillary incisors is indispensable in camouflage treatment of anterior crossbite. It is always, therefore, challenging for orthodontists to place the maxillary incisors in an appropriate anteroposterior position with a harmonious labial inclination in Class III treatment. To prevent excessive proclination of the maxillary incisors, distal en-masse movement of the mandibular dentition is quite effective in camouflage treatment for patients with a Class III malocclusion. The multiloop edgewise archwire is considered a practical method with fewer side effects. However, the extent of occlusal enhancement that occurs in response to the multiloop edgewise archwire greatly depends on a patient’s compliance and can vary with each person. As skeletal anchorage, the application of miniscrews, which offer more simple and stable force systems, has gradually become popular and reliable.
Fig 1. Pretreatment photographs.

Fig 2. Pretreatment study casts.
In this case report, we introduce a nonsurgical treatment of an adult with a Class III malocclusion with miniscrew-assisted mandibular dentition distalization. At the beginning of the therapy, the multiloop edgewise archwire technique resulted in an unsatisfying smile because of the excessive proclination of the maxillary incisors. Then we stopped to vertically implant a pair of miniscrews in the external oblique ridge areas of the bilateral mandibular ramus as anchorage for the distal en-masse movement of the mandibular dentition and obtained an excellent treatment outcome ultimately.

**DIAGNOSIS AND ETIOLOGY**

The patient was a 20-year-old Mongolian woman who had a Class III facial type and slight crowding with a complete Class III relationship. Her chief complaint was an anterior crossbite. Her medical history showed no contraindication for orthodontic therapy, and no one in her direct family had skeletal Class III features.

**Table. Cephalometric measurements**

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Pretreatment</th>
<th>After 4 months of multiloop edgewise archwire treatment</th>
<th>Posttreatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>SNA (°)</td>
<td>79.1</td>
<td>77.8</td>
<td>77.6</td>
</tr>
<tr>
<td>SNB (°)</td>
<td>81.7</td>
<td>79.2</td>
<td>79.1</td>
</tr>
<tr>
<td>ANB (°)</td>
<td>−2.6</td>
<td>−1.4</td>
<td>−1.5</td>
</tr>
<tr>
<td>SN-GoGn (°)</td>
<td>36.1</td>
<td>39.0</td>
<td>38.9</td>
</tr>
<tr>
<td>S-Go/N-Me (%)</td>
<td>61.3</td>
<td>59.4</td>
<td>59.4</td>
</tr>
<tr>
<td>FH-OP (°)</td>
<td>9.9</td>
<td>8.7</td>
<td>6.6</td>
</tr>
<tr>
<td>U1-SN (°)</td>
<td>79.6</td>
<td>64.7</td>
<td>77.7</td>
</tr>
<tr>
<td>L1-NB (°)</td>
<td>18.4</td>
<td>24.0</td>
<td>13.5</td>
</tr>
</tbody>
</table>

In this case report, we introduce a nonsurgical treatment of an adult with a Class III malocclusion with miniscrew-assisted mandibular dentition distalization. At the beginning of the therapy, the multiloop edgewise archwire technique resulted in an unsatisfying smile because of the excessive proclination of the maxillary incisors. Then we stopped to vertically implant a pair of miniscrews in the external oblique ridge areas of the bilateral mandibular ramus as anchorage for the distal en-masse movement of the mandibular dentition and obtained an excellent treatment outcome ultimately.

**Fig 3. A, Pretreatment cephalogram; B, panoramic radiograph; C, cephalometric tracing.**
The photographs taken before treatment showed symmetric facial structures (Fig 1). The patient had a concave facial profile, a protrusive lower lip, and an acute nasolabial angle. Her maxillary anterior teeth were retrognathic, with inadequate display when smiling. The mandibular dental midline was deviated 2.0 mm to the right, although the maxillary dental midline was coincident with the facial midline. There were no signs or symptoms of temporomandibular joint dysfunction. Mandibular movements, such as maximal opening and lateral and anterior displacement, were within normal limits. No deviation and pain were discovered during the border movement of the mandible. The dental casts (Fig 2) showed a Class III occlusion on each side, without apparent crowding. Overjet was \( -2.0 \text{ mm} \), and overbite was \( -4.5 \text{ mm} \). A cephalogram (Fig 3, A) and a panoramic radiograph (Fig 3, B) were taken before treatment. The cephalometric analysis (Table) and its tracing (Fig 3, C) showed that the mandible protruded relative to the cranial base (SNB angle, 81.7°; ANB angle, −2.6°). The panoramic radiograph (Fig 3, B) showed no other abnormal signs, except that the 2 germs of the mandibular third molars were tipped mesially.

After the analysis of the photographs, casts, and radiographs, it was decided to approach her problems as a skeletal Class III malocclusion with an anterior crossbite and a deviated midline.

**TREATMENT OBJECTIVES**

The treatment objectives were to (1) obtain a harmonious facial profile by decreasing the protrusion of the mandible; (2) improve the occlusion, including correction of the anterior crossbite, establishment of ideal overjet and overbite, and achievement of Class I molar relationships; and (3) place the dental midlines in the middle of the patient’s face.

**TREATMENT ALTERNATIVES**

The first alternative was combined surgical and orthodontic treatment. The anterior crossbite would be corrected with a mandibular setback, and the concave profile would be improved as well. However, we decided that her skeletal problem was not sufficiently excessive to require orthognathic surgery.

The second alternative was orthodontic treatment with extraction of 4 premolars. Through the retraction of the mandibular anterior teeth and the mesial movement of the maxillary molars, the anterior crossbite and Class III molar relationships would be corrected, and the concave facial profile would be camouflaged. Nevertheless, her mandibular incisors were not suitable for much distal movement because of the thin trabecular bone in the mandibular anterior area that could damage the periodontal tissues by gingival recession, fenestration, or dehiscence.

The third alternative was to extract the mandibular third molars and use the multiloop edgewise archwire technique to obtain distal en-masse movement of the mandibular arch with short Class III elastics. Thereby, the anterior crossbite would be corrected, the molar relationships would be changed into Class I, and her concave facial profile would be camouflaged as well.
After we discussed the 3 alternatives with the patient, she chose the third option and promised to cooperate in extracting the third molars and wearing the Class III elastics.

**TREATMENT PROGRESS**

Orthodontic treatment began on November 9, 2007. The mandibular third molars were extracted before bonding. Preadjusted 0.022-in brackets (Shiye, Hangzhou, China) were bonded to all teeth. Alignment and leveling with sequential nickel-titanium archwires were achieved in 12 months, ending with 0.018 × 0.025-in stainless steel wires. After that, 0.018 × 0.025-in stainless steel multiloop edgewise archwires with progressive tip-back bends were placed in both arches.

**Fig 5.** A and B, Photographs after 4 months of multiloop edgewise archwire treatment; C, cephalogram after 4 months of multiloop edgewise archwire treatment; D, superimposed cephalometric tracings before treatment and after 4 months of multiloop edgewise archwire treatment.
The patient was instructed to wear the short Class III elastics (3/16 in, 6 oz; 3M Unitek, Monrovia, Calif) for 24 hours per day (Fig 4, A).

The anterior crossbite was corrected substantially 4 months later. However, the maxillary incisors were proclined remarkably. Class I molar relationships were not completely established, although the overall occlusion was improved significantly. Thus, in the 17th month, we took a set of photos (Fig 5, A and B) and a cephalogram (Fig 5, C), and made a cephalometric analysis (Table) to reestimate her treatment. The superimposition of the cephalograms (Fig 5, D) showed that the correction of the anterior crossbite was mostly because of the proclined maxillary incisors without obvious distal movement of the mandibular incisors. Also, the excessively proclined maxillary anterior teeth made her facial profile worse, especially when smiling.

To reinforce the distal en-masse movement of the mandibular dentition, we modified the treatment plan. We replaced the orthodontic appliance with 0.022-in Damon III self-ligating brackets (Sybron Dental Specialties Ormco, Orange, Calif) and used miniscrews instead of the multiloop edgewise archwire technique. When rebonding, the maxillary incisor brackets were rotated 180°, assisting in labial root torque at the rectangular wire stage. The miniscrews were implanted vertically in the external oblique ridge areas of the bilateral mandibular ramus between the mandibular first and second molars, where the greatest thickness of buccolingual bone was found (Fig 6).19

After 3 months of releveling, we started to draw the mandibular dentition distally using nickel-titanium coil springs with 300-g forces on each side. The spring was connected from the miniscrew to the hook between the mandibular canine and the first premolar. At the same time, 0.019 × 0.025 beta-titanium alloy wire was used to control the root position of the maxillary incisors. Six months later, the anterior overbite and overjet were improved remarkably, and the labial inclination of maxillary teeth was also much better (Fig 4, B).

The total treatment duration was 32 months. The multiloop edgewise archwire technique was used for 4 months, and it took 12 months for the distal en-masse movement of the mandibular dentition with miniscrews. The miniscrews were stable all the time and removed under topical anesthesia.

Fig 6. A, Frontal x-ray showing the positions of the miniscrews in the mandible; B and C, the positions of the miniscrews in the oral cavity.
TREATMENT RESULTS

A harmonious facial balance, a charming smile, and a well-aligned dentition were obtained (Fig 7). The anterior crossbite was corrected, and Class I molar relationships were achieved (Fig 8). The posttreatment cephalogram and panoramic radiograph are shown in Figure 9. The cephalometric analysis (Table) and the superimposition (Fig 9, C) show that the ANB angle increased from $-2.6^\circ$ to $-1.5^\circ$, and the SNB angle decreased from $81.7^\circ$ to $79.1^\circ$. According to the superimposition, the mandibular anterior teeth were retracted about 4 mm without negative lingual inclinations. The movement of the mandibular first molar could be considered almost bodily translation because its crown was moved 4.0 mm distally, and its roots were moved 3.0 mm distally. The maxillary incisors were moved labially under control with good inclination (U1-SN, $77.7^\circ$). The SN-GoGn angle increased from 36.1° to 38.9°, and S-Go/N-Me decreased from 61.3% to 59.4%, indicating that the mandible had rotated clockwise slightly. The patient was satisfied with the treatment results, and the outcome was stable after 1 year of retention (Fig 7, C).

DISCUSSION

For this patient, the etiology of her Class III malocclusion was expressed through mandibular protrusion. The changes contributing most to the correction of her initial dental and skeletal discrepancies were dentoalveolar compensation with distal en-masse movement of the mandibular dentition: a combination of clockwise rotation of the mandible and counterclockwise rotation of the occlusal plane. Ideal overjet and overbite were achieved with controlled labial movement of the
maxillary incisors and retraction of the mandibular anterior teeth.

The anteroposterior position of the maxillary incisors is important for the harmony of the face and the beauty of the smile. To standardize the orthodontic esthetic analysis, Andrews and Andrews\textsuperscript{20} noted the “6 elements of orofacial harmony,” for which the patient’s forehead is used as a stable landmark to determine the anteroposterior position of the maxillary incisors in the smiling profile. The facial axis point of the maxillary central incisors should touch the goal anterior limit line, when the teeth in each arch conform to element I (ie, arch shapes and lengths are optimal).\textsuperscript{20} Either in front of or behind the goal anterior limit line is not a favorable anteroposterior position for the maxillary central incisors. However, the labial inclination of maxillary incisors can vary and have remarkably different effects on facial esthetics, even if the facial axis point touches the goal anterior limit line and the anterior teeth have good overbite and overjet. Furthermore, the maxillary incisors can hardly be placed in a standard position for Class II or Class III camouflage treatment because of the skeletal discrepancy. Consequently, more or less inclination of the maxillary incisors is inevitable; this can greatly impact the static and dynamic beauty of the facial profile. Previously, we found that the maxillary incisor that is upright or in a slight lingual inclination is preferable.\textsuperscript{21} Labioversion of the maxillary incisors can easily ruin a pleasing smile, especially for a patient with a Class III facial type.\textsuperscript{2,21} Thus, identifying an efficient way to achieve maximum distal en-masse movement of the mandibular arch should be a primary goal in Class III camouflage treatment for adults.

We used the multiloop edgewise archwire technique at the beginning of this treatment. However, the occlusal enhancement in response to this technique depends on the patient’s cooperation and can vary with each patient. Also, labial tipping of the maxillary incisors generally occurs as a negative effect of anterior anchorage loss during molar distalization. As a result, the U1-SN was 64.7°, which was 14.9° less than the initial status after 4 months of multiloop edgewise archwire treatment. Apparently, the overproclined maxillary incisors compromised the pleasing smile. To minimize this side effect, we used miniscrews instead of the multiloop edgewise archwire to reinforce the distal retraction of the
mandibular arch and create enough overjet to upright the labially inclined maxillary incisors. The miniscrews were implanted vertically so that they would not block the way for the distal movement of the mandibular dentition. The mandibular incisors were successfully retracted about 4.0 mm without undesirable tipping, and the movement type of the mandibular molars was almost bodily translation.

Enlow et al\(^{22}\) stated that it is critical to move the occlusal plane counterclockwise during skeletal Class III therapy. In this patient, the Frankfort horizontal to occlusal plane angle decreased gradually, along with an increase of the SN-GoGn angle (Table). These changes demonstrated that the combination of counterclockwise rotation of the occlusal plane with clockwise rotation of mandible can be obtained not only by the multiloop edgewise archwire technique, but also with miniscrew-assisted mandibular arch distalization. Multiloop edgewise archwires can reconstruct the occlusal plane by uprighting and intruding the posterior teeth, and extruding the mandibular incisors with short elastics.\(^{23}\) However, the same effects can be obtained by miniscrews. The mandibular arch can be rotated counterclockwise during the distal en-masse movement because the direction of the retraction force applied on the miniscrews is above the center of mandibular arch resistance, leading to a flattened occlusal plane (Fig 10). On the other hand, molar distalization, which contributed mostly to the clockwise rotation of mandible, was beneficial for alleviating the negative overbite. With the combination of retracted mandibular incisors, the anterior crossbite could be

Fig 9. A, Posttreatment cephalogram; B, panoramic radiograph; C, superimposition.
Fig 10. Because the direction of the retraction force applied to the miniscrews is above the center of mandibular arch resistance, the mandibular arch can be rotated counterclockwise when distalized, leading to a flattened occlusal plane. On the other hand, molar distalization is beneficial for decreasing a negative overbite. With the combination of these 2 factors, the anterior crossbite can be corrected, and ideal overbite and overjet can be established. The dotted line represents the retraction force; the red point represents the center of mandibular arch resistance.

CONCLUSIONS

The use of miniscrews in the posterior area of the mandible is an effective approach for Class III camouflage treatment. Not only can the occlusal plane be flattened in conjunction with clockwise rotation of the mandible, but also it is beneficial to control the labial inclination of the maxillary incisors for the en-masse mandibular arch distalization. Therefore, this technique requires less compliance and is particularly useful for correcting Class III patients with mild mandibular protrusion and minor crowding. Identically, Class II patients with a mildly protrusive maxilla are also candidates for en-masse maxillary arch distalization with miniscrews implanted in the posterior area of the maxilla. The outcome of this case was stable after 1 year, although more follow-up is necessary to determine the long-term stability.

REFERENCES